(12) UK Patent Application (19) GB (11) 2 289 688 (13) A

(43) Date of A Publication 29.11.1995

(21) Application No 9509997.4

(22) Date of Filing 17.05.1995

(30) Priority Data
(31) 08250176 (32) 27.05.1994 (33) US

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(51) INT CL[6]
C09K 3/32 , B01D 17/022 , C02F 1/40 , C10G 33/04 , E02B 15/04

(52) UK CL (Edition N)
C5E EDM ESD ESS

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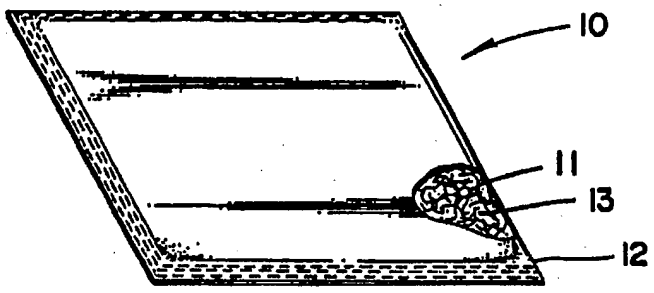
(58) Field of Search
UK CL (Edition N) C5E EDM ESA ESD ESR ESS ESW
INT CL[6] B01D 17/02 17/022 , B01J 20/28 , C02F 1/40 , C09K 3/32 , C10G 33/00 33/04 33/06 , C10M 175/00 175/04 175/06 , E02B 15/04 , E03F 5/14 5/16
Online : WPI, CLAIMS

(54) Absorbent articles for treating fluid organic waste

(57) A pouch 10 comprises a permeable fabric cover 12 containing a mix of fibres 11, which provide capillary action, and absorbent material 10, which is capable of forming a solid, viscous liquid or gel with the fluid to be absorbed. The article is especially useful for absorbing oil from waste, particularly aqueous, the fibres being of a synthetic polymer and the absorbent being a styrene or olefin based polymer. A number of pouches may be formed into a quilt or they may be incorporated into a filter column.

Fig- 1



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At least one drawing originally filed was informal and the print reproduced here is taken from a later filed formal copy

Fig- 1

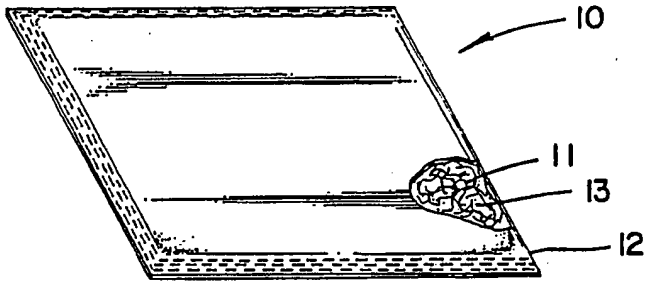


Fig- 2

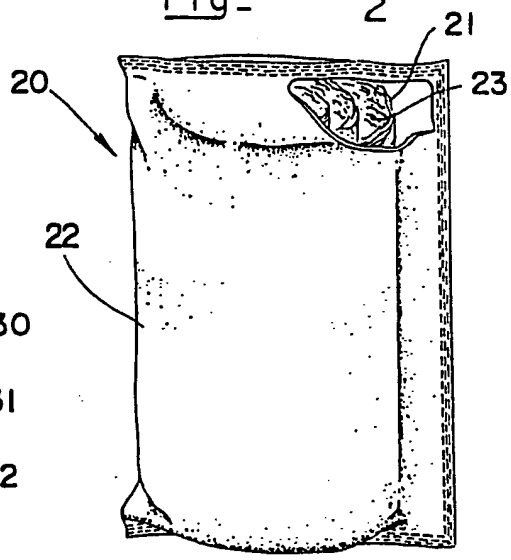


Fig- 3

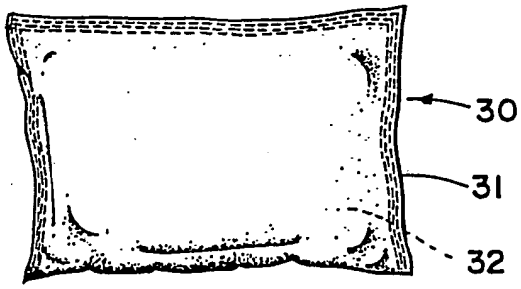


Fig- 4

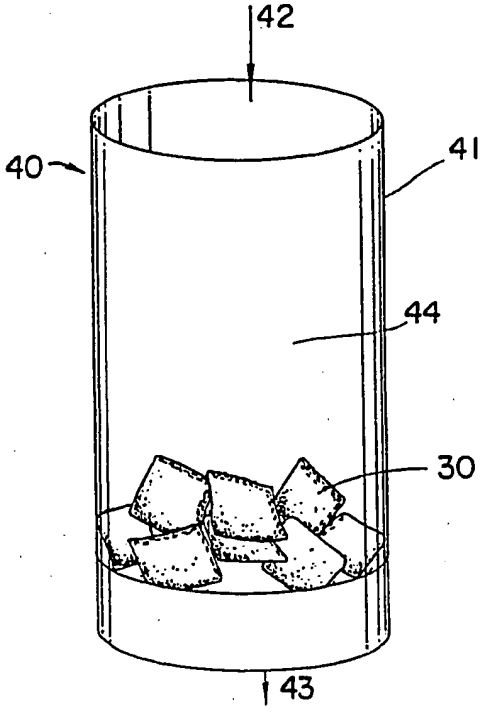


Fig- 5

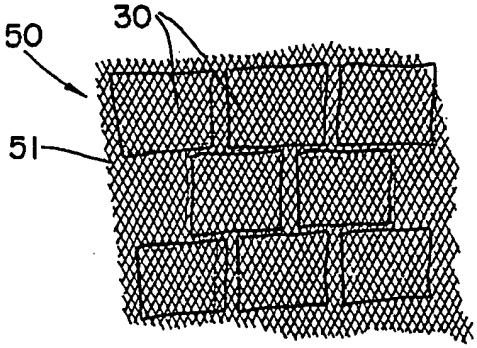


Fig- 6

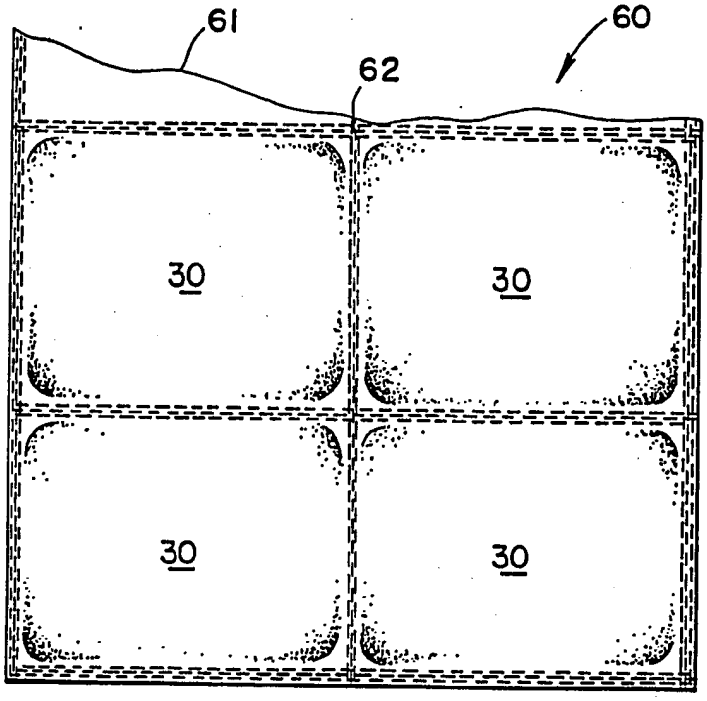
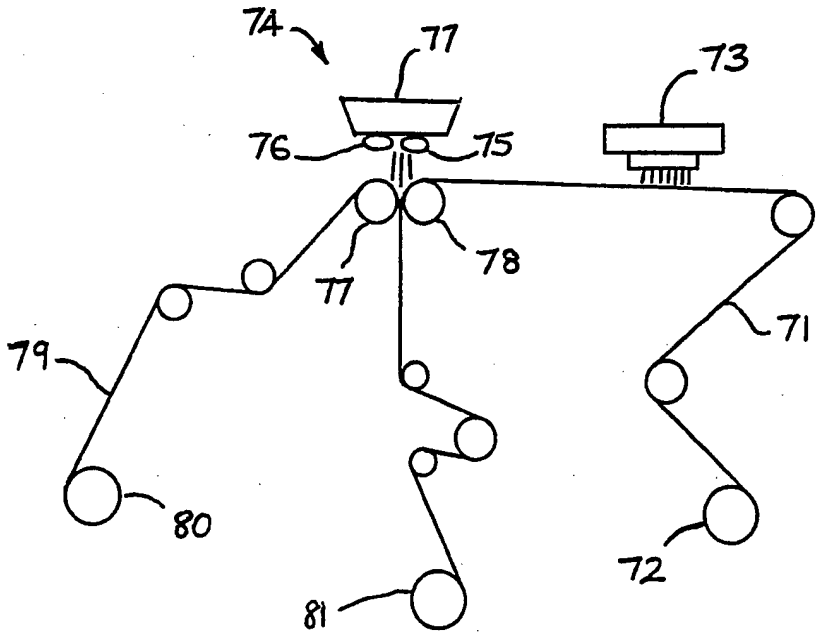


Fig- 7



ARTICLES AND METHODS FOR SORBING, FILTERING AND DISPOSING OF FLUID WASTE

Background of the Invention

The present invention relates to articles and methods for sorbing and immobilizing fluid waste, especially organic fluids.

Many products have been designed and sold for sorbing fluid waste, especially organic liquid waste, such as oil. In particular, there are many products available for cleaning up oil spills from the surface of bodies of water, land, or factory floors.

There is no currently available product that is capable of both sorbing liquid waste and immobilizing it in a form that is suitable for disposal in a landfill. As a result, such products are difficult to retrieve and handle after they have become saturated with waste. In addition, many of these products do not make efficient use of the contained sorbent materials because sorbent particles positioned near the surface of the product become saturated with oil or other liquid waste and prevent any additional liquid waste from being sorbed by particles located in the interior of the product.

Summary of the Invention

An article for sorbing and immobilizing fluid waste is provided. The article has a high loft web of fibers that are capable of carrying the fluid waste by capillary action but do not absorb the waste. Dispersed in the high loft web is a sorbent material, in the form of particles, powders, fibers or mixtures thereof. An adhesive may be used to attach the sorbent material to the web. The sorbent material is capable of sorbing the organic fluids and forming either a solid, a high viscous liquid, or a gel with the sorbed fluid. Surrounding the high loft web and dispersed sorbent material is a fabric cover which is permeable to the organic fluid and impermeable to the sorbent material.

The present invention also includes a method for removing liquid waste from the surface of a liquid or solid by placing the sorbent article of the invention of the surface of the liquid or solid from which the liquid

waste is to be removed and allowing the sorbent article to sorb the liquid waste and form either a solid, a highly viscous liquid, or a gel with the sorbed liquid waste.

The present invention also includes a method for filtering a stream of fluid and removing one or more contaminants therefrom by providing a filter having finely divided sorbent material dispersed in a web of fibers and having a fabric cover. The method includes causing the stream of fluid to flow through the filter and allowing the filter to sorb the contaminants, while allowing liquids such as water to pass through.

The present invention further includes a filter column and method for filtering a fluid and removing at least one contaminant therefrom. The filter column has an inlet, an outlet and a flow channel therebetween and a plurality of sorbent pouches positioned in the flow channel. Each of the pouches has finely divided sorbent material enclosed in a fabric cover, the sorbent material being capable of sorbing at least one contaminant, and the fabric cover being permeable to the liquid waste and impermeable to the finely divided sorbent material.

The present invention further includes a sorbent article for sorbing fluid waste, the article having a flexible casing that is permeable to the fluid waste, the flexible casing containing a plurality of sorbent pouches containing finely divided sorbent material enclosed in a fabric cover, the sorbent material being capable of sorbing liquid waste, and the fabric cover being permeable to the liquid waste and impermeable to the finely divided sorbent material.

Brief Description of the Drawings

Figure 1 shows the sorbent articles of the invention with a portion of the fabric cover cut away to show the interior structure of the article;

Figure 2 shows a second embodiment of the sorbent articles of the invention in the shape of a cylindrical boom with a portion of the fabric cover cut away from one end to show the interior structure of the boom;

Figure 3 shows a sorbent pouch that may be used to make the filter column and sorbent articles of the invention;

Figure 4 shows the filter column of the invention;

Figure 5 shows a sorbent article containing sorbent pouches according to the invention;

Figure 6 shows the sorbent quilt of the invention;

Figure 7 shows an example of an apparatus that may be used to manufacture the high loft web according to a preferred embodiment of the invention.

Detailed Description of the Invention

Figure 1 shows a preferred embodiment of the sorbent article of the invention. The sorbent article 10 has a high loft web of filters 11 and a fabric cover 12. Dispersed in the high loft or bulky web are sorbent particles 13. The article shown in Figure 1 is in the form of a rectangular pad, which can be used for sorbing fluids such as organic liquids from the surface of a solid or liquid, i.e., absorbing spilled oil from the surface of land, water or a floor. The article shown in Figure 1 could also be used as a filter for removing contaminants from a stream of liquid or gas. The article can be made in many different shapes and sizes.

Figure 2 shows a second preferred embodiment of the sorbent article of the invention. The sorbent article 20 has a high loft or bulky web of fibers 21, which is rolled up to form a cylinder which is enclosed in a fabric cover 22. Uniformly dispersed in the high loft fibrous web are sorbent particles 23. A plurality of the cylindrical articles may be fastened together end to end and used to form a boom for absorbing organic liquids from the surface of a solid or liquid, for example, for removing or confining an oil spill on the surface of a body of water.

Figure 3 shows a pouch that may be used to make a filter column or sorbent quilt. The sorbent pouch 30 has a fabric cover 31 containing sorbent particles 32. A plurality of filter pouches 30 may be assembled into a filter column, which is shown in Figure 4; a sorbent article, which is shown in Figure 5; or a sorbent quilt, which is shown in Figure 6.

In Figure 4, filter column 40 has a container 41 with an inlet 42, an outlet 43, and a flow channel 44 therebetween. Positioned in the flow

channel 44 between inlet 42 and outlet 43 are a plurality of sorbent pouches 30. In Figure 5, sorbent article 50 has mesh net 51 containing a plurality of sorbent pouches 30. In Figure 6, sorbent quilt 60 has a plurality of sorbent pouches 30 arranged in a layer between two fabric sheets 61. The fabric sheets 61 are fastened together along seams 62 between each filter pouch 30.

The high loft or bulky web of fibers used to make the sorbent articles of the invention may be formed from polyester, polyolefin, or polyamide (nylon) fibers. The polymers may be homopolymers or copolymers. Examples of polyester fibers suitable for use in making the high loft web include polyethyleneterephthalate and polybutyleneterephthalate. Examples of suitable polyolefins are polyethylene and polypropylene. Examples of suitable polyamides are nylon-6 and nylon-66. The preferred polymers are homo- and copolyers of ethylene and propylene.

The high loft fibrous web may also be formed from bicomponent fibers, for example, a fiber having a high strength core and a sheath that has desirable bonding characteristics, such as a fiber with a polyester core and a polypropylene sheath. Any two of the above-mentioned polymers may be used to make a bicomponent fiber. The bicomponent fiber may also be formed from two versions of the same polymer, for example, a high molecular weight core with a low molecular weight sheath.

Depending on the properties of the fluid waste to be sorbed, the fibers used to make the high loft web may be provided with a surfactant coating that renders the fibers either hydrophilic or hydrophobic. Useful surfactant coatings include Tritos made by Union Carbide, waxes such as Voltex, and silicones such as GE silicone. The high loft web may also be formed from blends of two or more different polymer fibers. Preferably, the fibers used to form the high loft web are of 1.2 to 15 denier, most preferably 5 to 6 denier, have a high modulus of elasticity, and have a cut length of 0.5 to 3 inches.

The high loft web may be formed by carding the polymer fibers or laying them down, for example, on a moving vacuum belt. The steps of extruding the polymer fibers and forming the high loft web may be combined, for example, in a spun bonding process, which is preferably followed by running the web through a calendar. After carding, laying down or spin bonding the web, the fibers are bonded together by chemical bonding, thermal bonding or mechanical bonding to form the high loft fibrous web structure. The preferred method of bonding is thermal bonding, for example, ultrasonic bonding. The high loft structure preferably has a thickness greater than 20 mils.

The fabric cover for the sorbent articles and sorbent pouches of the invention is preferably a nonwoven polymer web formed from polyolefin fibers, most preferably homo- or copolymers of propylene. Bicomponent fibers of, for example, polyolefins of polyesters, may also be used to form the nonwoven polymer web. Preferably, the fibers used to form the nonwoven polymer web are of 1.2 to 15 denier, most preferably 1.5 to 2 denier, have a low modulus of elasticity, and have a cut length of 0.75 to 3 inches. The fibers are preferably thermally bonded, but may also be chemically or mechanically bonded.

The polymer fibers used to make both the high loft web and the nonwoven polymer web may be manufactured from either virgin materials or recycled materials, or from blends of the two.

The sorbent materials dispersed in the high loft fibrous web are preferably styrene block polymers or polyolefins, which are suitable for selectively sorbing organic fluids. Examples of styrene block copolymers suitable for use as the sorbent material include polystyrene-polybutadiene-polystyrene, polystyrene-polyisoprene-polystyrene, and polystyrene-polyethylene/butylene-polystyrene. Examples of suitable polyolefins are polymers and copolymers of ethylene, propylene and isoprene. The sorbent material may be mixed with other materials such as silica or activated carbon in order to enhance the sorbing properties. The sorbent materials should be in the form particles, fibers, powders with particle

sizes ranging from 20 mesh to 400 mesh. Preferred polymers are sold under the trademarks WASTE-SET 3200 and WASTE-SET 3400. The polymers are permanently hydrophobic and selectively absorb hydrocarbons.

These sorbent materials will form a solid, highly viscous liquid, or gel with hydrocarbons. The rate of absorption and the final form of the waste-saturated sorbent material will depend on a variety of factors, including the molecular weight distribution of the polymer sorbent, the styrene content of the polymer sorbent, the surface area of the sorbent particles, fibers, or powders, the molecular weight distribution of the organic waste, the temperature and any mechanical action on the waste-saturated sorbent. The sorbent articles of the invention will sorb up to about six times their weight in fluid or liquid organic material. The sorbency will vary, however, depending on the foregoing conditions. The bulky fiber substrate serves to hold the particles in a spaced and evenly distributed relation.

In order to form the sorbent articles of the invention, the sorbent material may be dispersed in the high loft web by splitting the web in half along a plane parallel to the surface of the web, sprinkling the sorbent particles, fibers or powder inside the web and then reclosing it. Alternatively, the sorbent particles, fibers or powders may be dispersed in the high loft web during the process of forming the web, for example, by spraying the fibers and sorbent materials simultaneously onto a moving vacuum belt. Another method for dispersing the sorbent materials in the high loft web is to spray the sorbent material in liquid form onto the high loft web and then evaporate the liquid carrier.

After the sorbent material has been dispersed in the bulky web, the resulting web may be cut and/or assembled into the desired shape for the sorbent article, for example, by assembling several layers of the web or rolling the web to form a cylinder. The web is then encased in a fabric cover. The edges of the fabric cover may be fastened together, for example, by sewing or by thermal, chemical or mechanical bonding.

In order to form the sorbent pouches, a pouch is formed from a fabric cover, leaving an opening for filling the pouch with sorbent material. The filled pouch may be closed by any of the foregoing methods.

~~The sorbent articles may be used to sorb a broad range of organic materials in a liquid, vapor or gaseous state.~~ The sorbent articles may be used to sorb a broad range of organic materials in a liquid, vapor or gaseous state. The sorbent articles are advantageously used to sorb, for example, diesel fuel, gasoline, refined motor and hydraulic oils, crude oil and solvents such as trichloroethylene (TCE) and benzene, without the absorption of any water.

Additional applications include use of the sorbent articles as filters to remove organic liquids (such as benzene, toluene, ethylbenzene and xylene) from ground water, storm runoff water, water pumped from bilges of watercraft, storage tank condensate, storage tank cleaning water, or from treated waste water that is to be discharged into rivers. The sorbent structures may also be used to remove liquid or gaseous organic materials from vapor streams, for example, form the air that is discharged from paint booths, dry cleaning operations, air stripping operations or organic liquid storage vessels.

After the sorbent articles have become saturated with organic waste, they may be disposed as solid waste. Also, the saturated articles may be incinerated where allowed by applicable regulations or they may be used as a component in the manufacture of road asphalt and similar products.

EXAMPLES

Example 1: Method of dispersing sorbent particles in high loft web

Figure 7 illustrates a preferred method of manufacturing the high loft web with dispersed sorbent particles. A high loft or bulky fibrous web 71 is unwound from a first unwind mandrel 72. The fibrous web 71 then passes under an adhesive application head 73. The web then passes under a distribution head 74 for dispensing sorbent particles. The head 74 includes a knurled feed roll 75 and a brush roll 76 for metering the sorbent particles. The polymer is fed to the rolls via gravity hopper 77. The web

71 then passes through a nip section containing a chilled roll 77 and a coated roll 78. Optionally, a lightweight nonwoven sheet 79 may be added from a second unwind mandrel 80. The resulting two or three component web is then wound onto rewind mandrel 81 and can then be used in the fabrication of the sorbent articles, as described above.

Example 2: Method of fabricating sorbent pouches

One method of fabricating the sorbent pouches of the invention is by use of a conventional bag forming machine. In this example, a nonwoven polymer web that is twice the width of the finished pouch is introduced from a roll to the upstream end of the machine. First, the nonwoven web is folded in half. Then, the two side seams of each pouch are formed perpendicular to the direction of travel of the web by the use of a heat sealing device, forming a series of open-topped pouches still joined together in a single web. The continuous web of pouches is then cut into individual pouches by a knife and anvil arrangement which cuts between each heat sealed seam. The separated pouches are then conveyed individually to the filling section of the machine. At this point, an auger screw feeding device dispenses a predetermined amount of sorbent polymer particles into the open end of each pouch. The pouches, now about two-thirds full of sorbent polymer particles, are then conveyed to the top sealing section of the machine, where each pouch is sealed by the use of a heated head which clamps shut against an anvil on the top of the pouch, forming the top seam.

Once fabricated, the pouches can then be shipped in bulk to be used in a filter column or in the further fabrication of sorbent products, such as a quilt. If the pouches are to be used in a filter column, they can be loaded manually or pneumatically into the appropriate column. Once they have become saturated with waste material the pouches can be removed form the filter column manually or pneumatically, since the waste material has been sorbed and stabilized by the sorbent particles inside the pouch and not by the nonwoven web cover, avoiding the formation of a solid mass in the filter column.

Claims

1. An article for sorbing and immobilizing fluid organic waste, said article comprising:

(a) a high loft web of fibers that is capable of carrying said fluid organic waste by capillary action;

(b) at least one sorbent material selected from the group consisting of particles, fibers, powders, and mixtures thereof, said sorbent material being dispersed in said web of fibers and being capable of sorbing said fluid organic waste and forming one of a solid, a highly viscous liquid, and a gel with the sorbed fluid waste; and

(c) a fabric cover surrounding said web of fibers and dispersed sorbent material, said fabric cover being permeable to said fluid waste and impermeable to said sorbent material.

2. The article according to claim 1, wherein said web of fibers comprises polymeric fibers selected from the group consisting of polyolefins, polyesters, and polyamides.

3. The article according to claim 2, wherein said polymeric fibers are selected from the group consisting of homopolymers and copolymers of ethylene, homopolymers and copolymers of propylene, polyethyleneterephthalate, and polybutyleneterephthalate.

4. The article according to claim 1, wherein said web of fibers is impervious to said fluid waste.

5. The article according to claim 1, wherein said sorbent material comprises a styrene block copolymer.

6. The article according to claim 5 wherein said sorbent material selectively absorbs hydrocarbons.

7. The article according to claim 5, wherein said sorbent material is selected from the group consisting of polystyrene-polybutadiene-polystyrene, polystyrene-polyisoprene-polystyrene, and polystyrene-polybutylene/ethylene-polystyrene.

8. The article according to claim 5, wherein said sorbent material additionally comprises a material selected from the group consisting of silica and activated carbon.

9. The article according to claim 1, wherein said fabric cover is a nonwoven polymer web.

10. A method for removing liquid waste from the surface of a liquid or solid, said method comprising:

(a) providing a sorbent article comprising finely divided sorbent material dispersed in a web of fibers and having a fabric cover, said sorbent material being capable of sorbing said liquid waste and forming one of a solid, a highly viscous liquid, and a gel with the sorbed liquid waste, said web of fibers being capable of carrying said liquid waste by capillary action, and said fabric cover being permeable to said liquid waste and impermeable to said finely divided sorbent material;

(b) placing said sorbent article on the surface of the liquid or solid from which the liquid waste is to be removed; and

(c) allowing said sorbent article to sorb said liquid waste and to form one of a solid, a highly viscous liquid, and a gel with the sorbed liquid waste.

11. The method of claim 10 wherein said liquid waste is an organic liquid and the sorbent material selectively absorbs the organic liquid.

12. The method of claim 11 wherein the organic liquid comprises a hydrocarbon.

13. The method according to claim 10 wherein said sorbent material comprises a styrene block copolymer.

14. A method for filtering a stream of fluid andremoving at least one contaminant therefrom, said method comprising:

(a) providing a filter comprising finely divided sorbent material dispersed in a web of fibers and having a fabric cover, said sorbent material being capable of sorbing said at least one contaminant and forming one of a solid, a highly viscous liquid, and a gel with the sorbed

contaminant, and said fabric cover being permeable to said at least one contaminant and impermeable to said finely divided sorbent material;

(b) causing said stream of fluid to flow through said filter; and

(c) allowing said filter to sorb said at least one contaminant from said stream of fluid and to form one of a solid, a highly viscous liquid, and a gel with the sorbed contaminant.

15. A filter column for filtering a liquid and removing at least one contaminant therefrom, said filter column comprising:

(a) a container having an inlet and an outlet and a flow channel therebetween;

(b) a plurality of sorbent pouches positioned in said flow channel, each of said pouches comprising finely divided sorbent material enclosed in a fabric cover, said sorbent material being capable of sorbing said at least one contaminant, and said fabric cover being permeable to said at least one contaminant and impermeable to said finely divided sorbent material.

Examiner's report to the Comptroller under Section 17 (The Search report)	GB 9509997.4
Relevant Technical Fields (i) UK Cl (Ed.N) C5E (EDM, ESA, ESD, ESR, ESS, ESW); B1D (DCAA) (ii) Int Cl (Ed.6) C02F 1/40; C09F 3/32; C10G 33/00, 04, 06; C10M 175/00, 04, 06; B01D 17/02, 022; B01J 20/28; E02B 15/04; E03F 5/14, 16	Search Examiner R E HARDY Date of completion of Search 5 SEPTEMBER 1995
Databases (see below) (i) UK Patent Office collections of GB, EP, WO and US patent specifications. (ii) WPI, CLAIMS	Documents considered relevant following a search in respect of Claims :- 1 TO 14

Categories of documents

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A: Document indicating technological background and/or state of the art.

P: Document published on or after the declared priority date but before the filing date of the present application.

E: Patent document published on or after, but with priority date earlier than, the filing date of the present application.

&: Member of the same patent family; corresponding document.

Category	Identity of document and relevant passages		Relevant to claim(s)
X	EP 0545050 A2	(SCHWIEK) note Figure 4	1 and 14 at least
X, Y	EP 0479476 A1	(TERO TECH) whole document	1 and 14 at least
X	EP 0295911 A2	(DU PONT) see page 4 lines 20 to 28	1 and 14 at least
Y	WO 92/07918 A2	(TRYAM) see page 4 lines 14 to 18	1 and 14 at least
X	WO 90/13343 A1	(AGNEL) see page 3 lines 1 to 16	1 and 14 at least
X	US 5071564 A	(STEIN) see column 3 lines 22 to 40	1 and 14 at least
X	US 4965129 A	(BAIR) see column 4 line 23 onwards	1 and 14 at least
X	US 4792399 A	(HANEY) see column 3 lines 41 to 44	1 and 14 at least
X	US 4111813 A	(PREUS) see column 2 lines 49 to 51	1 and 14 at least

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